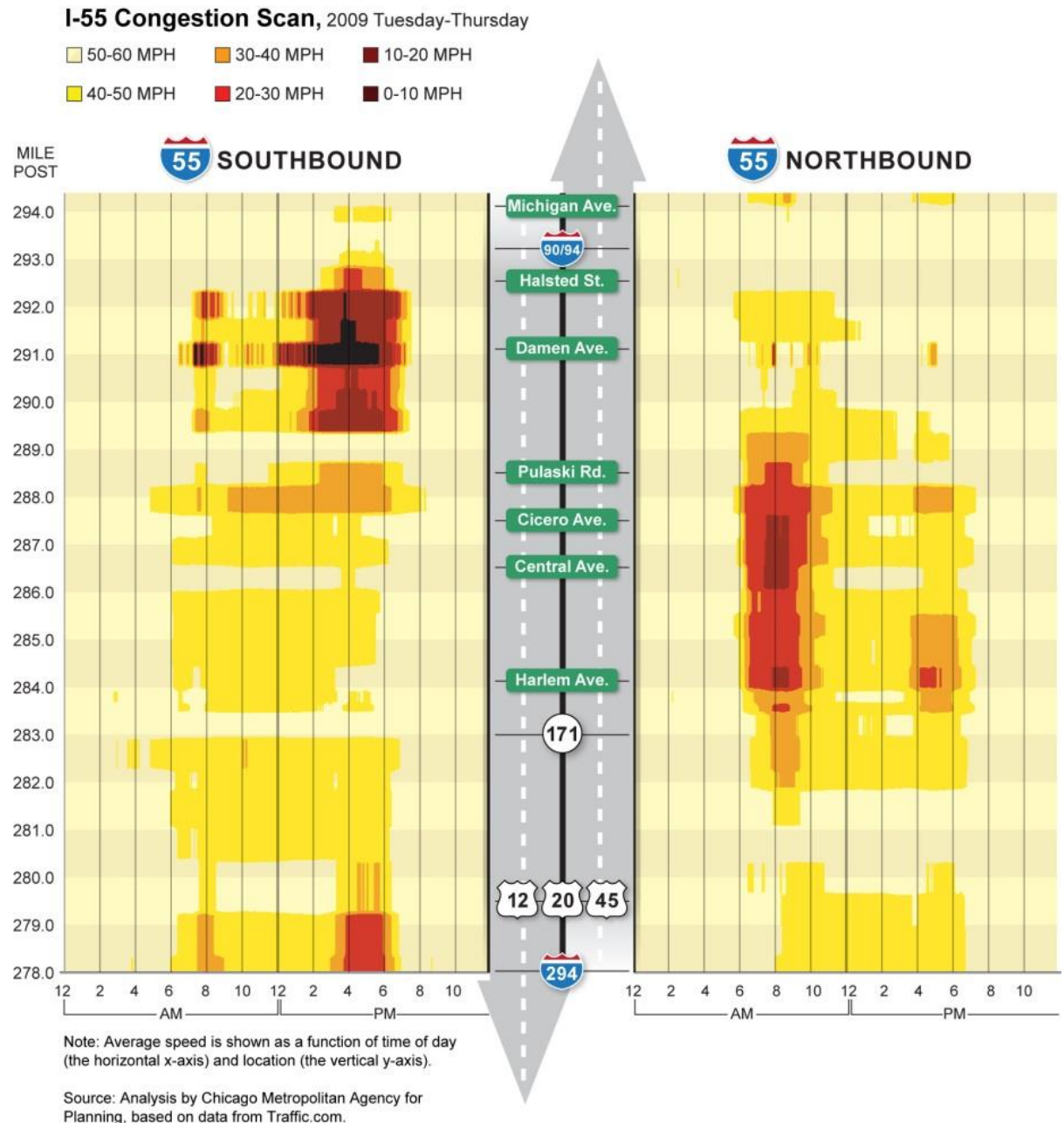# CMAP's experience with the National Performance Management Research Dataset (NPMRDS)

April 8, 2015
Presented by Tom Murtha and Todd Schmidt

Inductive loops provide excellent operations data that we can use for analyses such as CMAP's congestion scans (right)….

Image: CMAP

I-55 Congestion Scan, 2009 Tuesday-Thursday

- 50-60 MPH
- 40-50 MPH
- 30-40 MPH
- 20-30 MPH
- 10-20 MPH
- 0-10 MPH

55 SOUTHBOUND

55 NORTHBOUND

MILE POST

Michigan Ave.
90/94
Halsted St.
Damen Ave.
Pulaski Rd.
Cicero Ave.
Central Ave.
Harlem Ave.
171
12 20 45
294

Note: Average speed is shown as a function of time of day (the horizontal x-axis) and location (the vertical y-axis).

Source: Analysis by Chicago Metropolitan Agency for Planning, based on data from Traffic.com.

… but such data is only available for the region's expressway system.

The National Performance Management Research Dataset (NPMRDS) fills part of this gap.
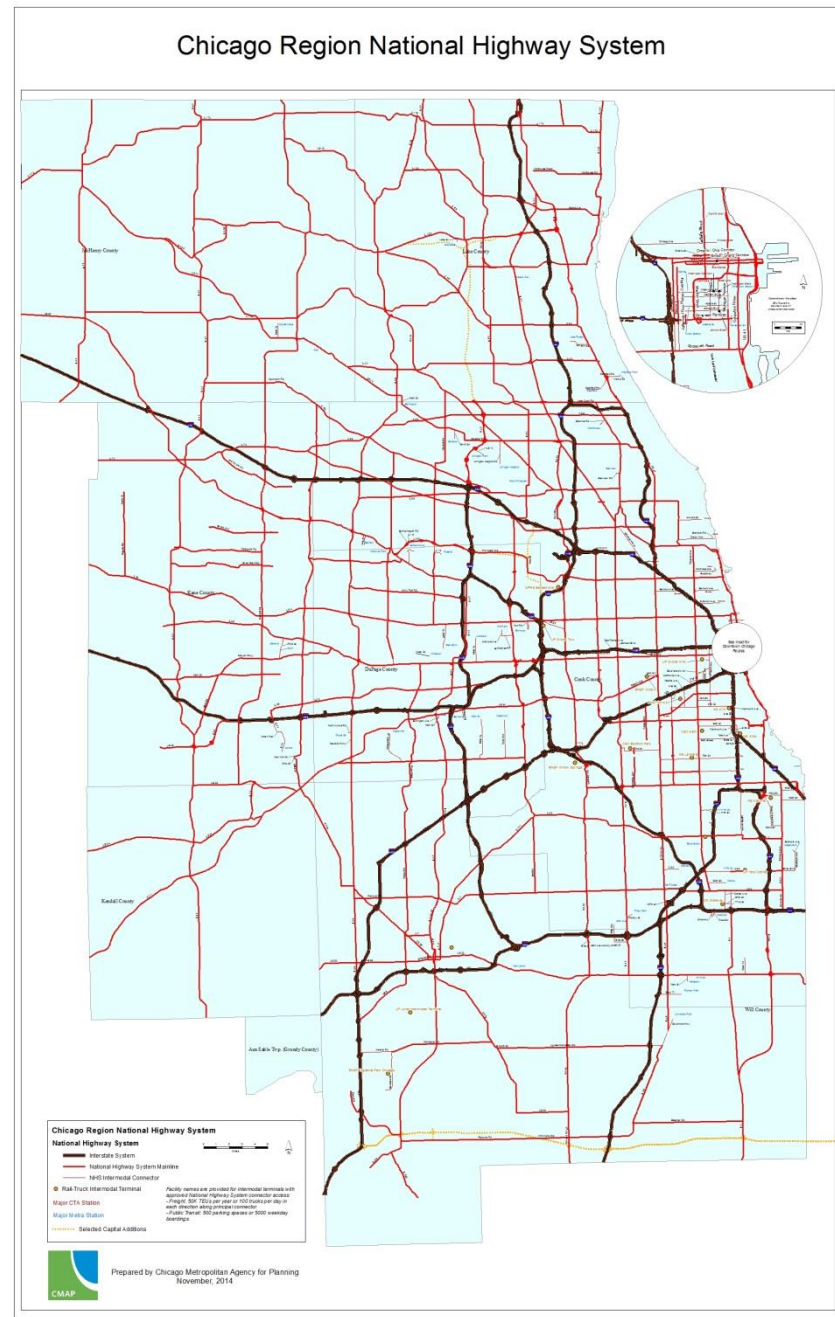
Chicago Region National Highway System

NPMRDS: Today's Agenda

- **Basic information about the NPMRDS**

- Database and Data Processing

- Geography

- What we're doing with the data

NPMRDS: Basics: Who

- The NPMRDS is provided to States and MPOs through an FHWA contract with HERE, the Chicago-based navigation data company.

- The data is collected by HERE from mobile phones, navigation device, and vehicle transponder probes; truck probe data is provided through the American Transportation Research Institute (ATRI).

- NPMRDS is available for work on IDOT and MPO contracts.

- Related probe data is available for purchase from HERE resellers and HERE'S competitors (TomTom, INRIX).

NPMRDS: Basics: What's in the Dataset?

- NPMRDS provides average travel time in seconds by Traffic Message Channel Code segment by direction every five minutes.

- TMC Code

  - What's a Traffic Message Channel (TMC)? A means of radio communication for traffic and travel data to and from motorists.   TMC location tables are typically integrated into vehicle navigation systems.

  - TMC Codes are maintained by an industry committee

- Date

NPMRDS: Basics: What's in the Dataset?

- Five-minute time slices are coded to 288 epochs per day.
- Vehicle travel times are reported for trucks, passenger cars, and all vehicles.
- Data is provided for each state every month (not real-time).
- Data is only provided when there is vehicle data (no imputation of speeds).

NPMRDS: Basics: What's *Not* in the Dataset?

- Sample size is not in the dataset.

- The dataset has no information about the distribution of speeds.

- No traffic volume estimates are in the dataset.

- No incident data is in the dataset.

- No transit or bike/ped data is in the dataset.

NPMRDS: Basics: Dates

- Full dataset is available monthly from July, 2013.

- A Interstate system archive is available.

- The contract is four one-year options, extending to June 2017.

- Data provided under license may be used in perpetuity.

NPMRDS: Basics: Highway System

- Data is provided only for the National Highway System.
- The National Highway System consists of:
  - Interstate System;
  - Other Principal Arterials;
  - Certain roads important to Defense activities; and
  - Intermodal Connectors.
- Some NHS roads were found not to have TMC codes; these are being addressed. Also, NHS changes were approved last month. So the NPMRDS geography changes.
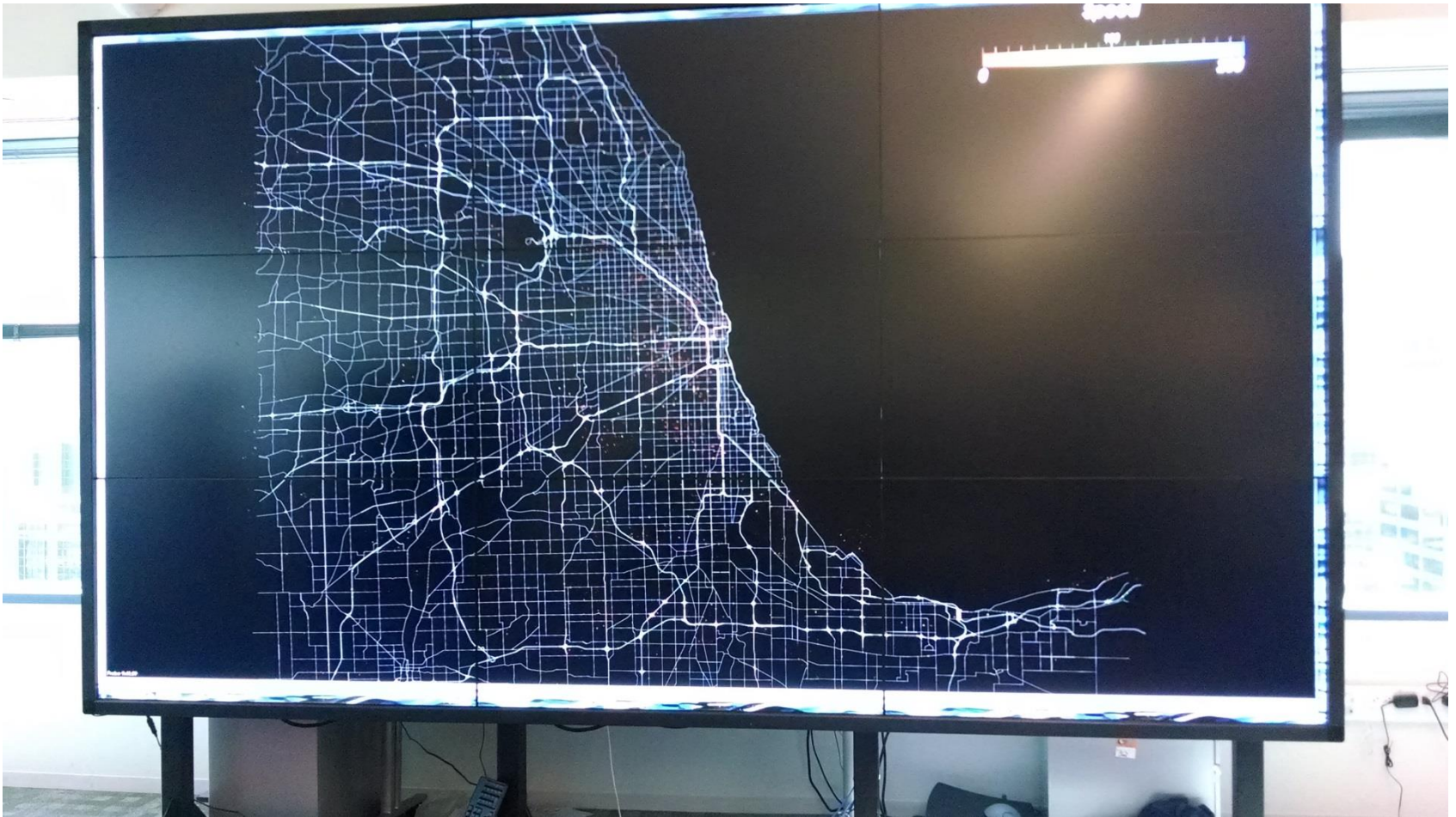
NPMRDS Basics: How Data Is Collected

- Vehicle probes data provides vector data: position, speed, and direction of travel.

- The probes are matched to road segments.

- These pieces are then strung together into the system of highways.

- Not calculated with capture/recapture methods (as with Bluetooth measurement).

- No vectors, no data….

NPMRDS Data: How Data Is Collected
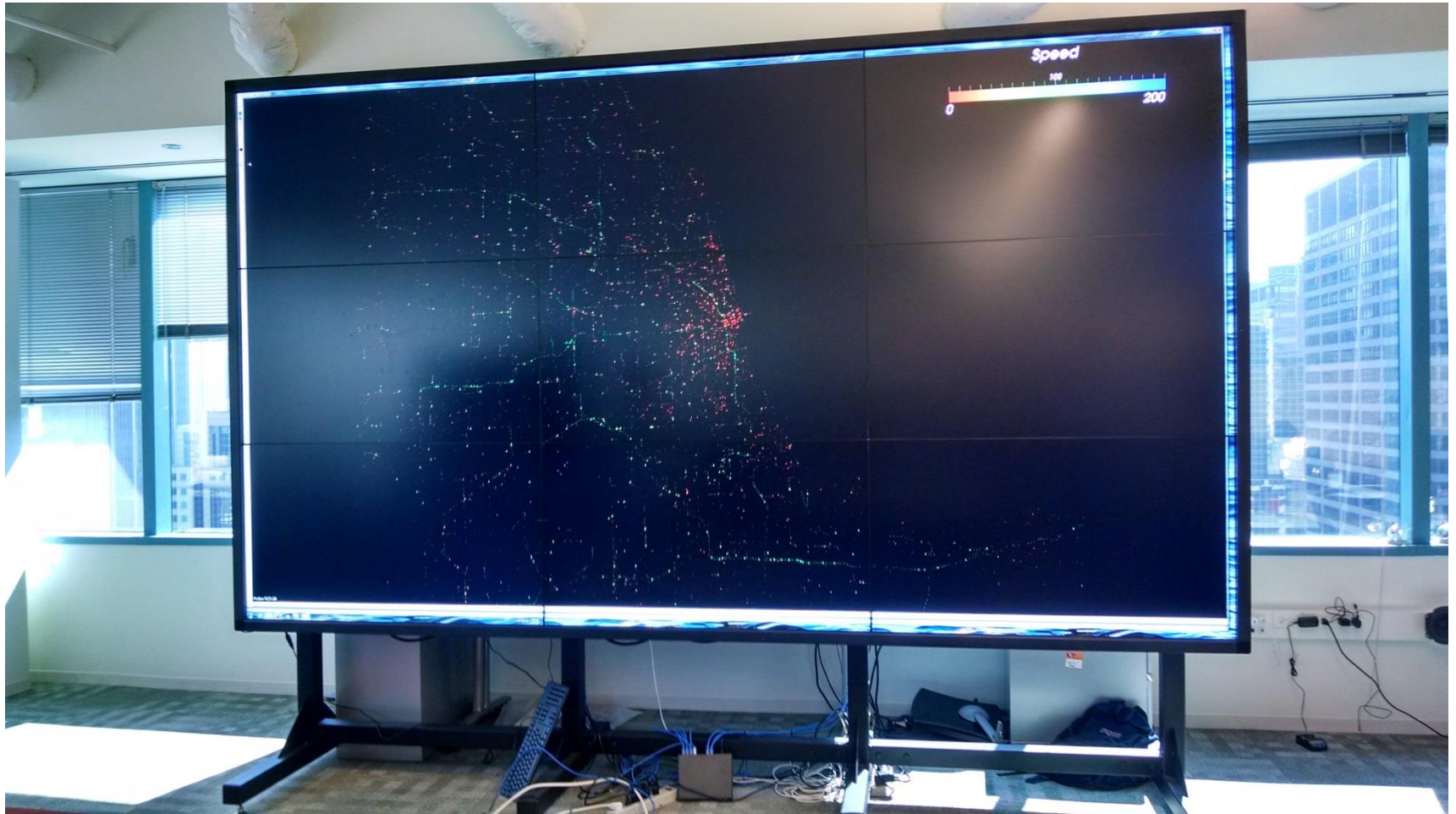
NPMRDS Basics: How Data is Collected

NPMRDS Basics: How Data Is Collected

NPMRDS Basics: Why

- Facilitate performance metrics using a nationally consistent database.

- Systems operations planning
  - First arterial dataset to really give us great data for use in reliability planning and incident management.

- Freight operations focus

- For CMAP: Performance-based programming

- For CMAP: CMAQ project evaluations

NPMRDS: Today's Agenda

- ☐ Basic information about the NPMRDS

- ☐ **Database and Data Processing**

- ☐ Geography

- ☐ What we're doing with the data

NPMRDS: Database Development

- Historical travel time released monthly
  - National Highway System on TMC network
  - Passenger, freight, and combined travel times
- 3 file types available
  - Travel time data, spatial data, and documentation
- Travel time data for IL ~1 gb per month with 25 million records

NPMRDS: Database Development

- PostgreSQL with PostGIS
  - Why PostgreSQL
    - Regional Transportation Data Archive Project
    - Open source
    - Geoprocessing capabilites
- Remote machine
  - 24 GB RAM
  - 1 TB disc space
  - Current database ~289 GB

NPMRDS: Data Processing

- ☐ Travel time in 5 minute increments (epochs)

- ☐ Outliers are included

- ☐ Invalid data points discarded

- ☐ No travel time estimation

| TMC	DATE	EPOCH	Travel_TIME_ALL_VEHICLES	Travel_TIME_PASSENGER_VEHICLES	Travel_TIME_FREIGHT_TRUCKS
107N04100	2052015	5	48	49	32
107N04100	2052015	6	46	41	49
107N04100	2052015	7	37	37	
107N04100	2052015	10	40	40	38
107N04100	2052015	11	87	87	88
107N04100	2052015	12	42	42	
107N04100	2052015	13	46	46	
107N04100	2052015	20	38	37	38
107N04100	2052015	21	8328	8328	
107N04100	2052015	24	9	6	17

NPMRDS: Data Processing

- Create full dataset with all epochs

- Add geographic data to main data table

- Convert travel time data to speed

- Flag outlier data

  - Currently set at travel time > 7200 seconds (2 hours) or speed > 100 mph

- Append to master data set

- Calculate performance measures and stats

|	epoch1 numeric(3,0)	tmc text	date text	tt_all numeric	tt_pas numeric	tt_fre numeric	date1 date	distance numeric	spd_all numeric	spd_pas numeric	spd_fre numeric	cmap_region boolean	ewgateway boolean	mon text	dow character varying(1)	flag integer
68	222	107P05316					2013-09-20							09	6	
69	58	107N07032					2013-09-17							09	3	
70	0	107N05596					2013-09-29							09	1	
71	120	107N12698	09192013	40	40		2013-09-19	0.22859	20.57310000000000000000	20.57310000000000000000		TRUE		09	5	
72	21	107N05135					2013-09-08							09	1	
73	220	107P05570					2013-09-29							09	1	
74	65	107P05660	09122013	39		39	2013-09-12	0.70044	64.65600000000000000000		64.65600000000000000000			09	5	
75	105	107P05660	09272013	40	40		2013-09-27	0.70044	63.03960000000000000000	63.03960000000000000000				09	6	
76	220	118P05583	09012013	325	312	340	2013-09-01	5.86664	64.98432000000000000000	67.69199999999999998800	62.11736470588235295600			09	1	
77	134	118P05583	09022013	320	320		2013-09-02	5.86664	65.99970000000000000000	65.99970000000000000000				09	2	
78	72	118P05583	09042013	325		325	2013-09-04	5.86664	64.98432000000000000000		64.98432000000000000000			09	4	
79	158	118P05583	09092013	320	320		2013-09-09	5.86664	65.99970000000000000000	65.99970000000000000000				09	2	
80	205	118P05583	09152013	325		325	2013-09-15	5.86664	64.98432000000000000000		64.98432000000000000000			09	1	
81	146	118P05583	09162013	320	320		2013-09-16	5.86664	65.99970000000000000000	65.99970000000000000000				09	2	
82	29	118P05583	09172013	320	320		2013-09-17	5.86664	65.99970000000000000000	65.99970000000000000000				09	3	
83	222	118P05583	09192013	325		325	2013-09-19	5.86664	64.98432000000000000000		64.98432000000000000000			09	5	
84	50	118P05583	09202013	320		320	2013-09-20	5.86664	65.99970000000000000000		65.99970000000000000000			09	6	
85	128	118P05583	09212013	320		320	2013-09-21	5.86664	65.99970000000000000000		65.99970000000000000000			09	7	
86	88	118P05583	09262013	343	343		2013-09-26	5.86664	61.57406413994169096000	61.57406413994169096000				09	5	
87	61	118P05583	09272013	338		338	2013-09-27	5.86664	62.48492307692307691200		62.48492307692307691200			09	6	
88	58	118P05583	09302013	350		350	2013-09-30	5.86664	60.34258285714285714800		60.34258285714285714800			09	2	
89	145	107N05191	09012013	40	40		2013-09-01	0.26101	23.49090000000000000000	23.49090000000000000000		TRUE		09	1	
90	51	107N05191	09022013	43	43		2013-09-02	0.26101	21.85200000000000000000	21.85200000000000000000		TRUE		09	2	

Scratch pad

Average Wednesday Speeds in September 2014
for Kennedy Expressway
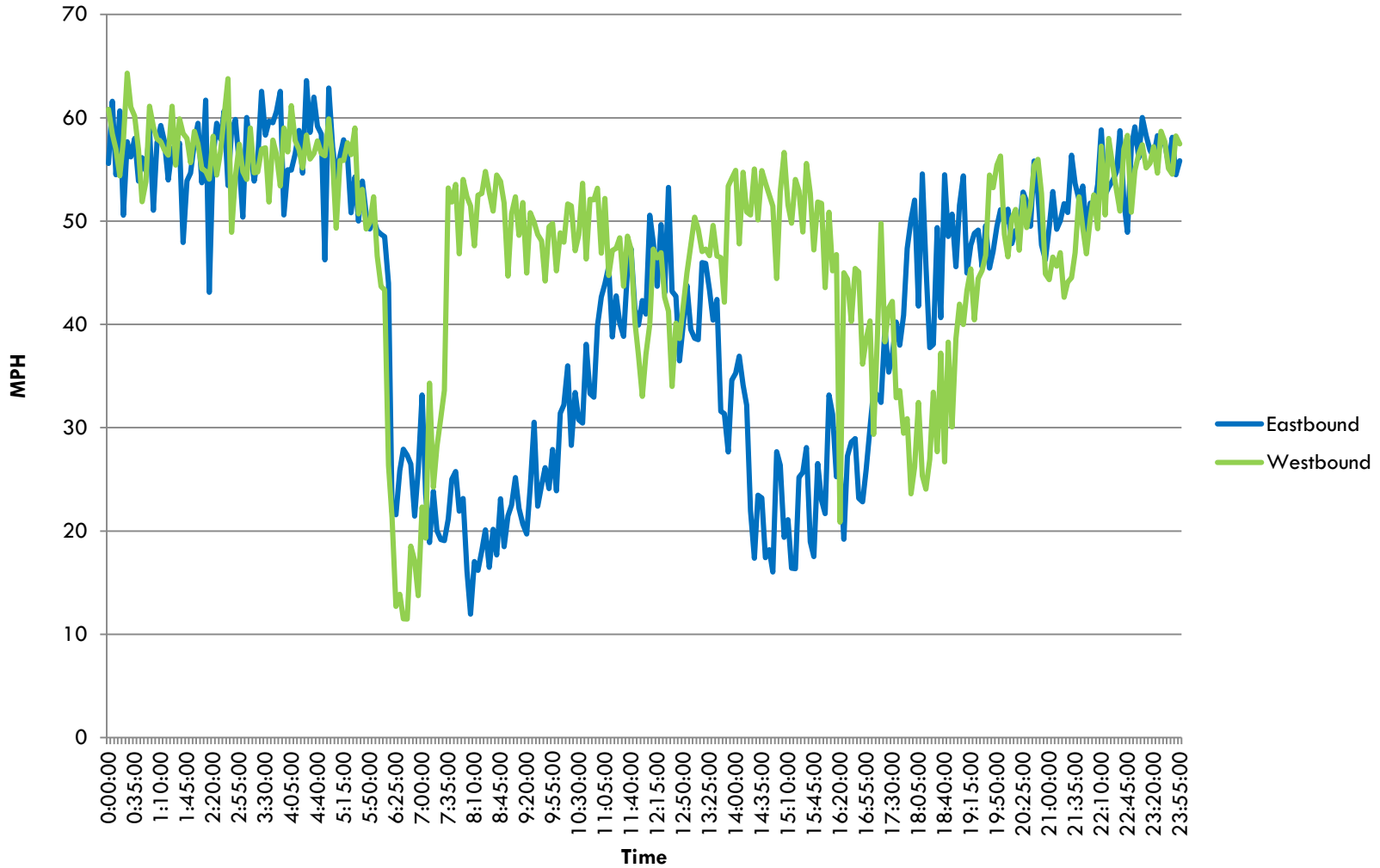
Speed Data for Wednesday, September 17, 2014

MPH

Time of Day

107N06696
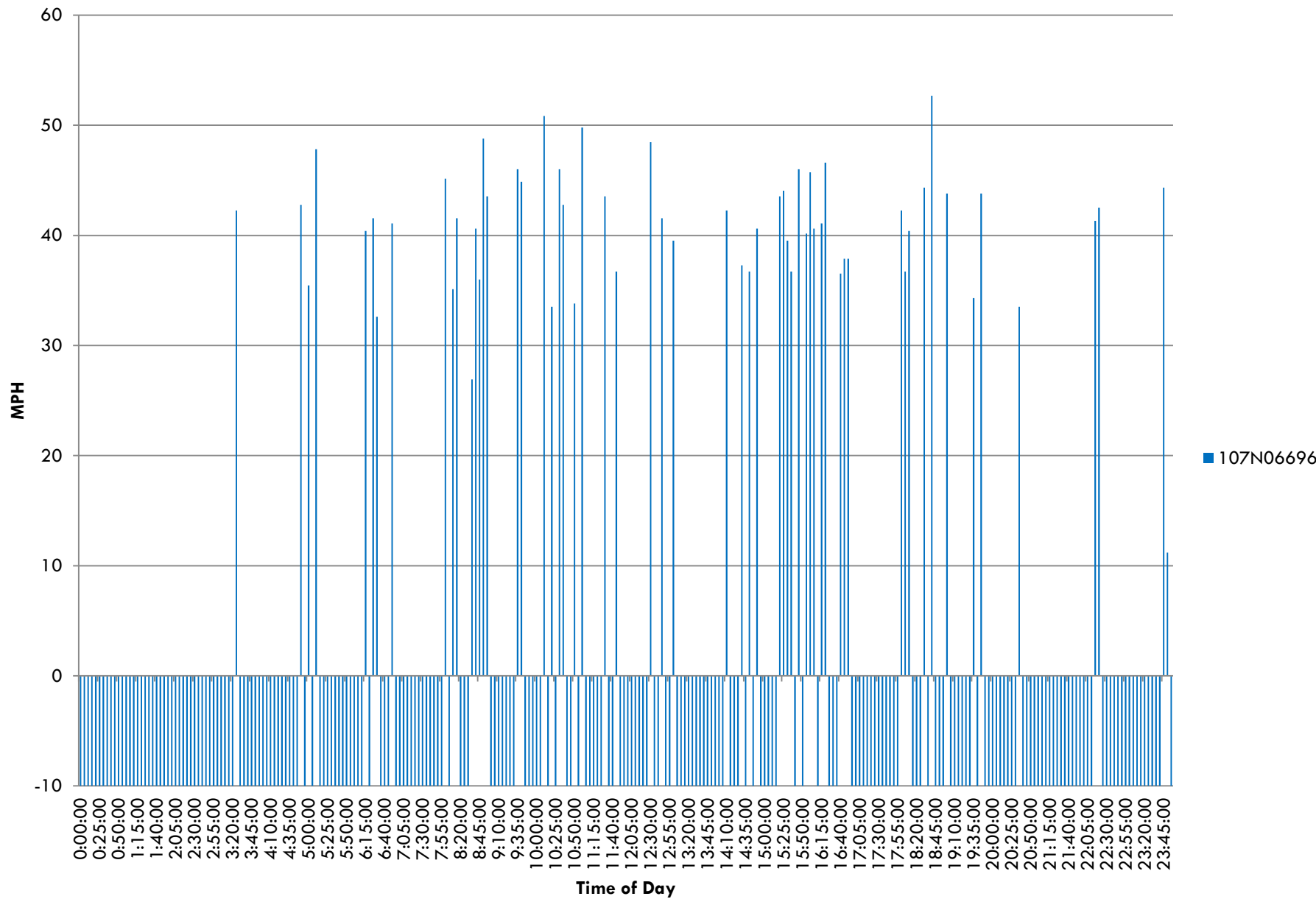
Average Speed for Wednesday in September, 2014
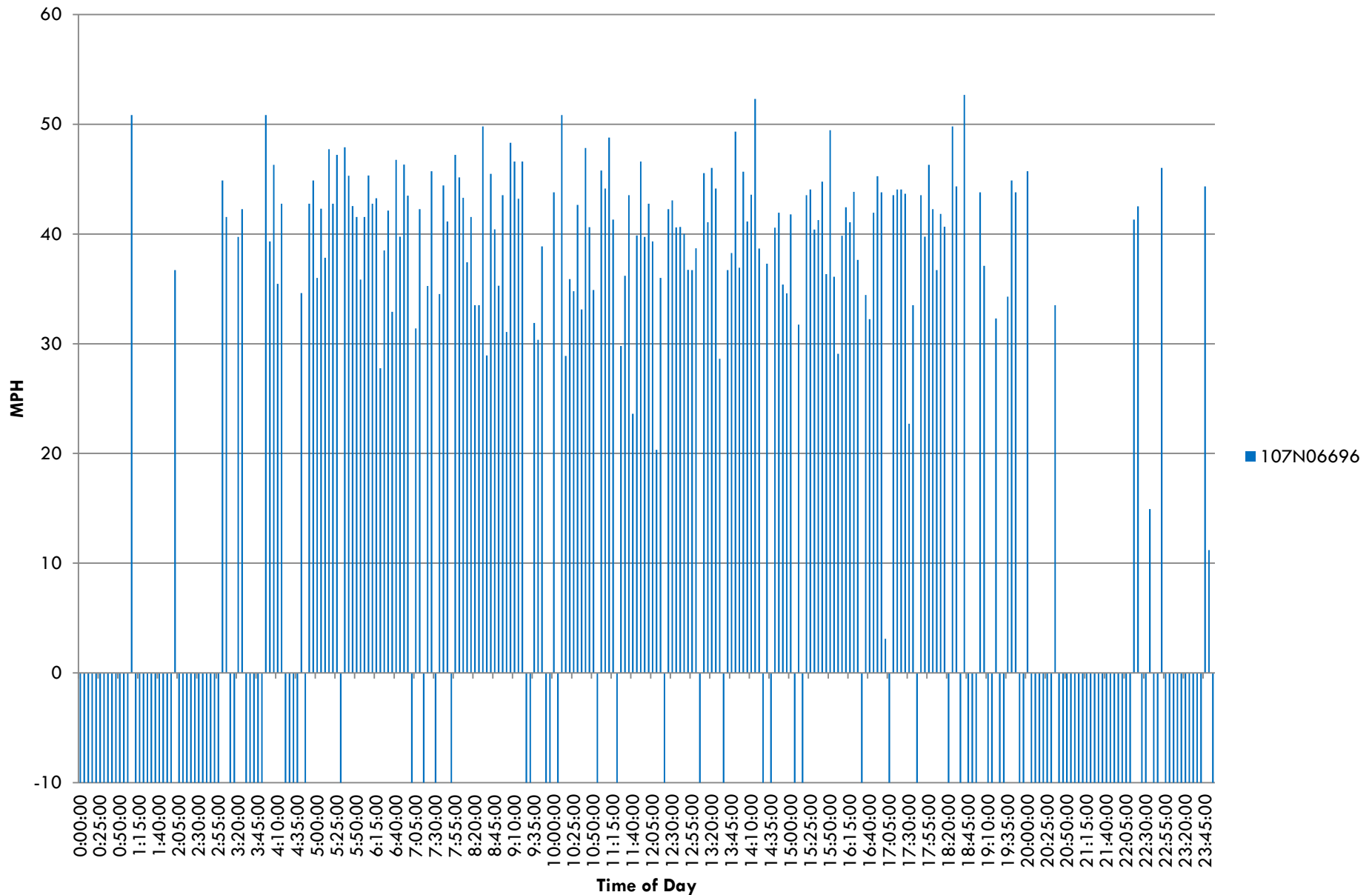
NPMRDS: Today's Agenda

- ☐ Basic information about the NPMRDS

- ☐ Database and Data Processing
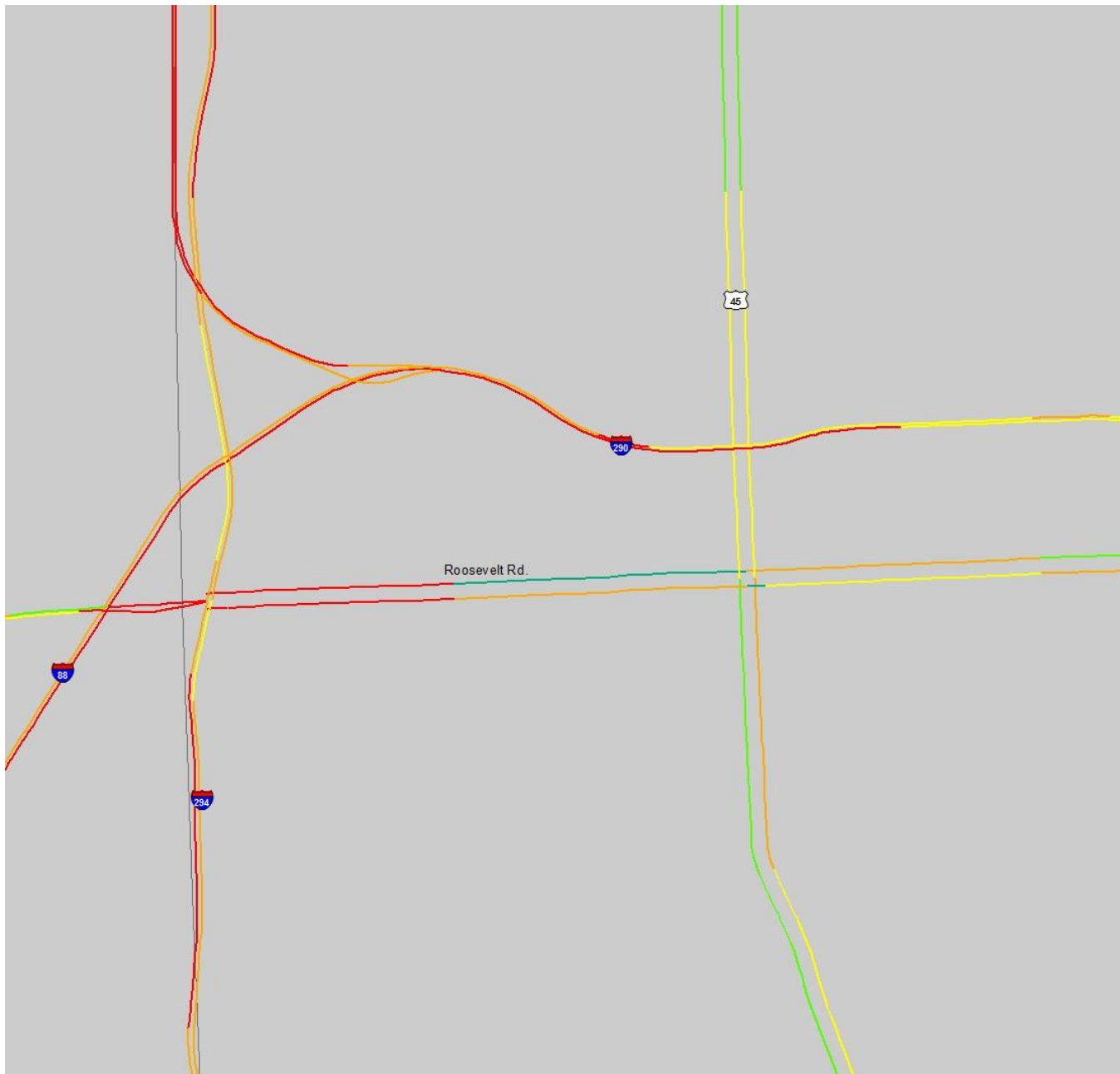
- ☐ **Geography**

- ☐ What we're doing with the data

NPMRDS Geography

- National Highway System on TMC network
- Shapefile updates
- Spatial data files
  - HERE Shapefile, TMC static file, TMC lookup table
- HERE Shapefile
  - GIS shapefile with roadway geometry
- TMC static file
  - Descriptive information about segment
- TMC lookup table
  - Lookup table to assign link ids a TMC

NPMRDS Geography

- Geoprocessing in PostgreSQL database
  - Identify TMC located in IL
  - Query TMC lookup table for link ids with a TMC identified in first step
  - Create spatial table with only IL links
  - Join IL spatial table with IL TMC look up table
  - Convert multi-line geometry to single-line geometry
  - Create parallel lines for display purpose

Roosevelt Rd.
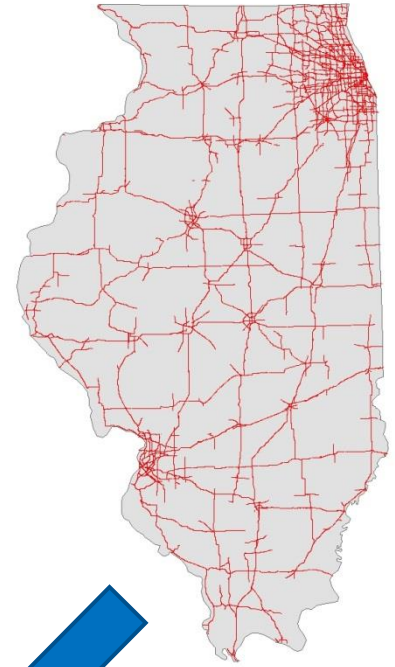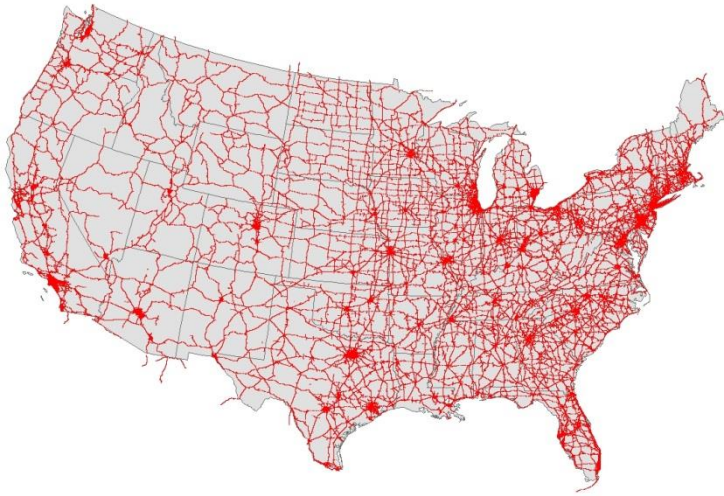
NPMRDS Geography

- Important geography note
  - HERE Link_ID to TMC relationship
    - Many link ids to one TMC
      - Divided roadways (dual carriageway)
    - Many link ids to Many TMCs
      - Undivided roadways
  - Few links assigned to more than 2 TMC's
  - Displaying data
    - Develop process to properly offset lines

NPMRDS Geography

- Conflation to IRIS
  - Iterative process to match HERE links to IRIS links
    - String matching on street name
    - Functional classification
    - Bearing (direction) of links
- Valuable tool
  - Add congestion performance data to IRIS
  - Project to score NHS network on IRIS

NPMRDS Geography

- Next steps
  - Conflate IRIS volumes to TMC geography
  - Add time of day profile from sensor data
  - Etc.

NPMRDS: Today's Agenda

☐ Basic information about the NPMRDS

☐ Database and Data Processing

☐ Geography

☐ **What we're doing with the data**

NPMRDS: What We're Doing With the Data: Performance Measurement

Uses of performance measures (FHWA):

- *Set goals and standards*

- *Detect and correct problems*

- *Manage, describe, and improve processes*

- *Document accomplishments*

NPMRDS: What We're Doing With the Data: Performance Measurement

Benefits of performance measurement (FHWA):

- *Greater accountability*

- *Improved transparency*

- *Facilitates assessment of system performance*

- *Refocus decision-making on outcomes*

- *Cost effectiveness*

NPMRDS: What We're Doing With the Data: Performance Measurement

CMAP's performance categorizations:

- ☐ Safety

- ☐ System Preservation

- ☐ Mobility

- ☐ Reliability

- ☐ Accessibility

- ☐ Equity

- ☐ Livability

NPMRDS: What We're Doing With the Data: Performance Measurement

Travel modes addressed:

- ☐ Auto
- ☐ Transit
- ☐ Freight
- ☐ Walking and Cycling

NPMRDS: What We're Doing with the Data: Performance Measurement

Where can we apply the NPMRDS?

Performance Category	Auto	Transit	Freight	Walking Cycling
Safety				
System Preservation				
Mobility	☑ Travel Time Index, Congested Hours, ?Delay?		☑ Travel Time Index, Congested Hours, ?Delay?	
Reliability	☑ Planning Time Index		☑ Planning Time Index	
Accessibility				
Equity				
Livability				

NPMRDS: What We're Doing with the Data: Performance Measurement

- Travel Time Index:

$$\frac{Average\ Congested\ Travel\ Time}{Free-Flow\ Travel\ Time}$$

- Planning Time Index:

$$\frac{95th\ Percentile\ Travel\ Time}{Free-Flow\ Travel\ Time}$$

- Congested Hours: Average Number of Hours per Weekday where Travel Time > (congestion factor X Free Flow Travel Time).

Peak periods for measuring congested travel time: 6am – 9am and 4pm – 7 pm

Free-flow travel time is average travel time measured from 8pm to 5:30 am, where samples > 10 [calculated using alternate dataset where samples were available].

For link level analyses, above processes are suitable. For regional-scale performance tracking, data must be weighted by VMT

NPMRDS: What We're Doing with the Data: Performance Measurement

- Regional Performance Mapping

- Quarterly Performance Reports in Development

- Anticipate that federal rules will require application of NPMRDS to a calculation of congestion and/or delay (requires conflation with a database containing highway traffic volumes).

NPMRDS: What We're Doing with the Data: IDOT Collaboration

- Sharing database development with IDOT and IDOT congestion consultants.
- Anticipate that this will be an on-going collaboration.
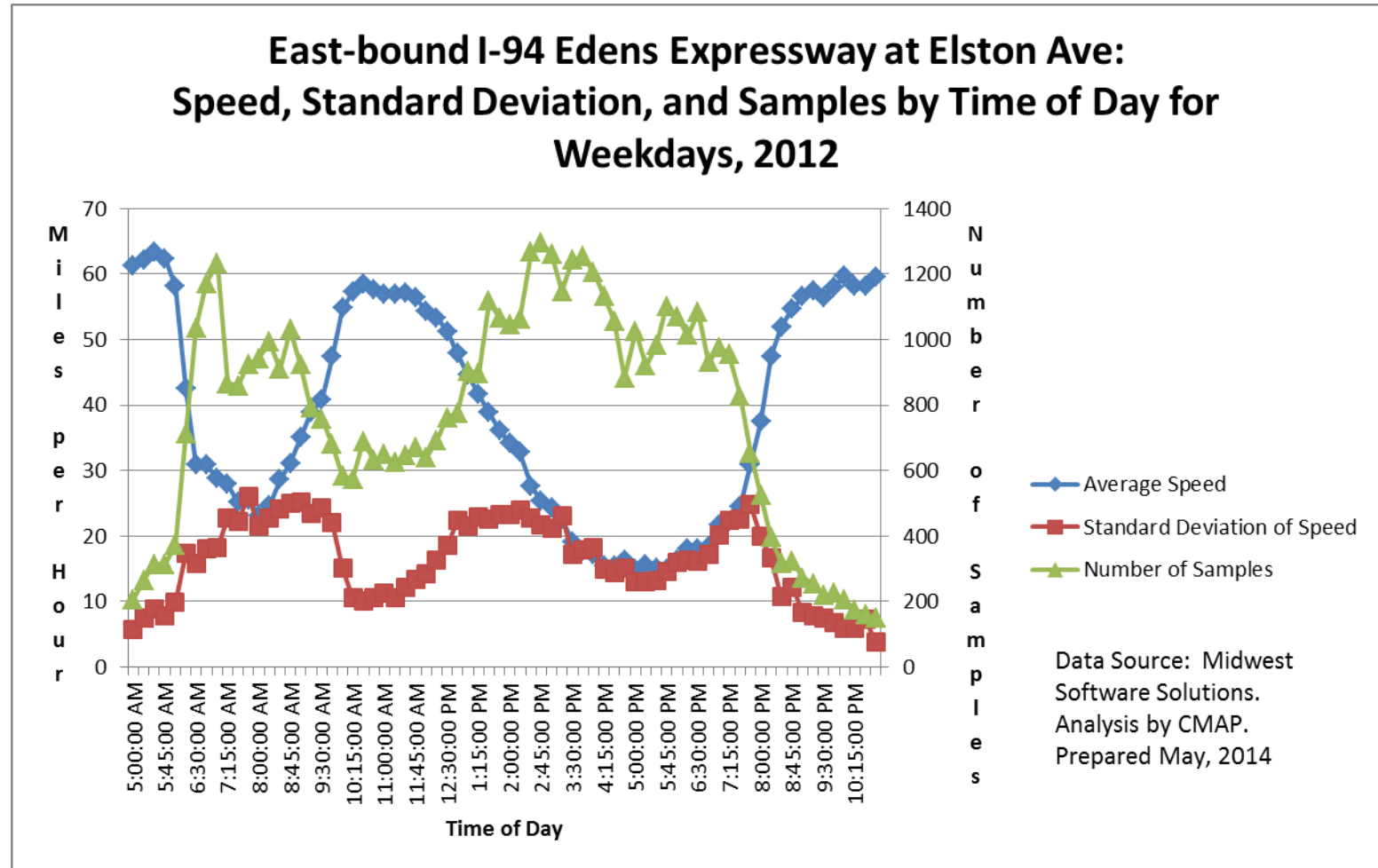
NPMRDS: What We're Doing with the Data: CMAQ Evaluations

- As part of effort to improve CMAQ project scoring process, planning time index data was used to evaluate the project submittals for the FY 2016-2020 program development process.

- Aside from measurement processing, this element of the CMAQ evaluations took only a few hours.

NPMRDS: What We're Doing with the Data: Analytical Deployment

- Analytical deployment of performance measures for performance-based programming
- Work of Research and Analysis at CMAP
- Perhaps subject of future CATMUG?

NPMRDS: What We're Doing with the Data: Project Evaluations

Data Source: Midwest Software Solutions. Analysis by CMAP. Prepared May, 2014